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Substance use as a risk factor for sleep problems among adolescents presenting to the Emergency Department

Olena Zhabenko, MD, PhD^{1,*}, Elizabeth Austic, PhD², Deirdre A. Conroy, PhD³, Peter Ehrlich, MD^{2,4}, Vijay Singh, MD, MPH, MS^{2,5}, Quyen Epstein-Ngo, PhD^{2,6}, Rebecca M. Cunningham, MD^{2,4}, and Maureen A. Walton, MPH, PhD^{2,3}

¹ Department of Psychosomatic Medicine and Psychotherapy, Ukrainian Research Institute of Social and Forensic Psychiatry and Drug Abuse, Ukraine

² University of Michigan Injury Center, University of Michigan School of Medicine, USA

³ Department of Psychiatry and Addiction Research Center, University of Michigan

⁴ Department of Surgery, University of Michigan, USA

⁵ Department of Emergency Medicine, University of Michigan, USA

⁶ University of Michigan Institute for Research on Women and Gender, USA

Abstract

Objectives—To determine correlates of sleep problems among adolescents. Specifically, to assess the relative strength of associations between sleep problems and: dating victimization, reasons for emergency department (ED) visit, depression, unhealthy alcohol use, and other drug use (marijuana, nonmedical use of prescription opioids, stimulants, and tranquilizers).

Methods—1,852 adolescents aged 14-20 presenting for care to the University of Michigan Emergency Department, in Ann Arbor, Michigan, (2011-2012) self-administered a computerized health survey. Sleep problems were identified if any of the 4 items on the Sleep Problems Questionnaire were rated by a patient as greater than 3 on a 0-5 scale. Adolescents that were too sick to be screened in the ED were eligible to participate in the study during their inpatient stay. Exclusion criteria for baseline included: insufficient cognitive orientation precluding informed consent, not having parent/guardian present if <18 years-old, medical severity precluding participation, active suicidal/homicidal ideation, non-English speaking, deaf/visually impaired, or already participated in this study on a prior visit.

Results—23.5% of adolescents reported clinically significant sleep problems. Female gender, depression, dating victimization, tobacco use, nonmedical use of prescription medication, and an ED visit for medical reasons were each associated with sleep problems among adolescents, even

Corresponding Author: Olena Zhabenko, 8a M. Kotsubinskiy str., Kyiv, Ukraine, 01030, Phone: +38 044 406 97 50; FAX: +38 044 465 17 21; olena.zhabenko@gmail.com.

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while controlling for age, other types of drug use, receiving public assistance, and dropping out of school.

Conclusions—These exploratory findings indicate that ED-based screening and brief intervention approaches addressing substance use and/or dating victimization may need to account for previously undiagnosed sleep problems.

Keywords

sleep; substance use; youth; dating victimization; emergency department

1. Introduction

Sleep is a physiological function which performs an important role in promoting growth, maturation, and the general health of children and adolescents (Kim et al., 2011). Sleep also contributes to school performance, and to cognitive and emotional functions (Dewald et al., 2010). Almost 70 % of US adolescents do not receive sufficient sleep (8 or more hours per night) and only 8 % report optimal sleep duration of 9 or more hours (Eaton et al., 2010). Research has shown a clear relationship between poor sleep and a number of adverse health behaviors, such as tobacco use (Bartel et al., 2014), alcohol consumption (Fernando et al., 2013), illicit drug use (Schierenbeck et al., 2008), suicide attempts (McKnight-Eily et al., 2011), and unintentional injury (Carskadon et al., 1990).

Adolescents who reported using the Emergency Department (ED) as their usual source of health care were more likely to report substance use and mental health problems (Wilson and Klein, 2000). In 2010, there were approximately 189,000 ED visits by persons under age 21 for injuries and other conditions linked to alcohol consumption (SAMSA, 2012). Additionally, EDs are used by many adolescents as a source of primary care (Gadomski et al., 1995). Research on the relationship between sleep problems and substance use among adolescents seeking care in the ED is lacking.

The relationship between substance use and sleep problems is likely bidirectional. Physiologically, the fact that alcohol is a sedative and can induce rapid onset of sleep may contribute to its use to fall asleep, while the resultant disturbance of nighttime sleep quality may result in daytime impairment or sleepiness. Alcohol also disturbs nighttime sleep quality, though, which may result in daytime impairment. Alcohol withdrawal, in turn, may result in insomnia, which could contribute to the continued craving and urge to resume drinking seen among chronic alcoholics (Vitiello, 1997). Poor sleep quality may also increase alcohol risk via maladaptive coping capacities, such as using alcohol to self-medicate (Digton and Landry, 2013). Adolescents may use alcohol to decrease depressive mood (Deykin et al., 1987), and use stimulants to increase energy, daytime alertness, and sociability (Romanelli and Smith, 2006).

In a parallel manner, use of other substances with sedative qualities (for example, marijuana, non-medical use of prescription sedatives, hypnotics, and opioids) may also be associated with sleep disturbance among adolescents. Consistent with this notion, epidemiological studies have found that marijuana use is positively related to insomnia among adolescents

(Johnson and Breslau, 2001). Recent studies have documented the positive relationship between non-medical use of prescription sedatives or opioids and sleep problems among college students (McCabe et al., 2014). On the other hand, non-medical use of stimulants such as Adderall has been shown to be positively associated with sleep problems among adolescents (Gromov and Gromov, 2009) and college students (Lakhan and Kirchgessner, 2012).

In terms of other risk behaviors, one study found that 17% of female and 9% of male adolescents reported dating violence (Ackard et al., 2003). Studies are needed to examine sleep problems in relation to dating violence among youth, especially given that dating violence is positively associated with alcohol and other substance use among youth (Epstein-Ngo et al., 2013).

The objective of the current analysis was to investigate correlates of sleep problems among adolescents (ages 14-20) presenting to the ED for care. We anticipated that sleep disturbance would be more common in females than males. Additional hypotheses were that sleep problems would be positively associated with demographic characteristics, substance use, and other risk factors. Examining the relative influence of these multiple risk factors for sleep problems provides a unique opportunity to inform future intervention efforts for adolescents in this setting.

2. Methods

2.1. Study Setting and Design

The U Connect study analyzed secondary data from a larger clinical trial of a brief alcohol intervention for youth in the ED. Additional sleep data was obtained to examine the extent of sleep problems among young patients in the ED. Respondents completed a self-administered survey using a touch-screen tablet computer with audio headphones during the ED visit. Recruitment occurred at the University of Michigan, Department of Emergency Medicine in Ann Arbor, Michigan, an academic level-1 trauma center with a yearly census of approximately 85,000 patients. This research was approved by the University of Michigan Institutional Review Board (IRB). A Certificate of Confidentiality was obtained from the National Institutes of Health. Additional details about this study are available elsewhere (Singh et al., 2014).

2.2. Sample and Recruitment

Youth (ages 14-20) who presented to the ED were identified via an electronic medical record system. Trained research assistants (RAs) assessed patients in waiting rooms or treatment spaces. Exclusion criteria for baseline included: insufficient cognitive orientation precluding informed consent, not having parent/guardian present if <18 years-old, medical severity precluding participation (including, respiratory-contact precautions), active suicidal/homicidal ideation, non-English speaking, deaf/visually impaired, or already participated in this study on a prior visit. Inclusion/exclusion criteria are detailed in prior article (Singh et al., 2014). Admitted patients who were not approached in the ED were approached within 72 hours in the hospital. Patients were recruited 7 days a week (except major holidays) on

evening shifts (triaged 2 pm – 12 am) from September 2011 to September 2012, when youth are most likely to present for care. Day shifts (triaged 8 am – 2 pm) were randomly selected for sampling over the course of the study (2 - 7 days per week).

2.3. Screening Protocol

Following obtainment of written informed consent from the patient, or guardian if patient was under age 18 (and assent from minors), participants self-administered a 15-minute series of screening questionnaires on a touch-screen tablet computer with audio headphones. Patients' privacy was maintained by asking accompanying individuals to not to be in close proximity to the participant. The RA paused the survey during medical evaluations and procedures (for example, during analyses, x-rays, and consultations). Upon completion, participants chose a gift of \$1.00 value (such as pens, lip balm etc.). The survey was obtained solely for research purposes and was facilitated by research staff, but was self-administered by participants.

2.4. Assessment

2.4.1. Demographic Measures—Demographic information collected included gender, age, race, receiving public assistance and dropping out of school.

2.4.2. Substance Use—To assess alcohol use and binge drinking, participants completed a modified version of the Alcohol Use Disorders Identification Test-Consumption (AUDIT-C) (Bush et al., 1998) based on Chung and colleagues (Chung et al., 2002) adaptation of the AUDIT for adolescents, with a score of >3 for ages 14-17 and >4 for ages 18-20 indicating a positive screen for *unhealthy alcohol use*. Other substance use was measured using the Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST) (WHO ASSIST Working Group, 2002). Using the ASSIST, individuals specified whether or not they had any *tobacco* and *marijuana use* in the past year. Three ASSIST items measuring any non-medical use of prescription drugs in the past-year were introduced with the statement “In the past 12 months, have you used any of the following substances to get high, or taken them when they were prescribed to someone else, or taken more than what was prescribed to you?” Participants then responded yes or no for items representing three prescription drug classes: *nonmedical stimulant use* (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.), *nonmedical sedative use* (Valium, Serepax, Ativan, Xanax, Librium, Rohypnol, GHB, etc.), and *nonmedical opioid use* (Fentanyl, Oxycodone [OxyContin, Percocet], Hydrocodone [Vicodin], Methadone, Buprenorphine, Suboxone, etc.) separately.

2.4.3. Sleep—To assess sleep problems, participants completed the Sleep Problems Questionnaire (SPQ) (Jenkins et al., 1988). Its four items asked, “How often in the past month did you...”: (SPQ1) “Have trouble falling asleep?”; (SPQ2) “Wake up several times per night?”; (SPQ3) “Have trouble staying asleep (including waking far too early)?”; and (SPQ4) “Wake up after your usual amount of sleep feeling tired and worn out?” These four items (SPQ1, SPQ2, SPQ3, SPQ4) were used to define sleep problems (**Figure 1**). Participants rate each item on a scale of 0–5, based on the number of days a symptom was experienced, with 0 representing 0 days, 1 = 1-3 days, 2 = 4-7 days, 3 = 8-14 days, 4 = 15-21 days and 5 = 22–31 days in the past month. These four items were summed, with total

potential score fluctuating from 0 to 20, and with higher scores indicating greater insomnia. Based on prior work (Brower et al., 2011), patients were classified as having sleep problems if they rated any one of the four items as a four or five. Also, we adapted the following single item from the sleep disorders questionnaire (Douglass et al., 2003): “Did you use alcohol in order to get to sleep?” Using the SPQ response scale, the response to this item was coded as *Alcohol Sleep* (no/yes).

The Insomnia Symptom Questionnaire (ISQ), a 13-item self-rated scale designed to measure insomnia (Okun et al., 2009), was also used. For the purposes of this study, items 7-9 of ISQ were consolidated into a single question (in the past 30 days, did you have sleep difficulties that affected your work, social life or other important areas of your life?), and coded as *Affect Life* (no/yes).

2.4.4. Depression—The Patient Health Questionnaire 2-item depression (PHQ-2) screener is one of the most common brief depression screens (Richardson et al., 2010). The PHQ-2 investigates the frequency of depressed mood and anhedonia over the past two weeks. Its two items asked, “Over the past 2 weeks, how often have you been bothered by any of the following problems...” (PHQ1) “Little interested or pleased in doing things?” and (PHQ2) “Feeling down, depressed or hopeless?” These two items (PHQ1 and PHQ2) were used to define depressed mood. Patients rate each item on a scale of 0–3, with 0 representing “not at all”, 1 = “several days”, 2 = “more than half the days”, 3 = “nearly every day”. The PHQ-2 score ranges from 0 to 6. Based on prior work, we used a cut off of 2 or more to indicate a positive screen for *depression* (Kroenke et al., 2003).

2.4.5. Past-year victimization—Conflict in Adolescent Dating Relationships Inventory (CADRI) was designed as a self-report instrument to assess frequency of dating violence (Wolfe et al., 2001). Four items: “He/She threw something at me”, “He/She kicked, hit, or punched me”, “He/She slapped me or pulled my hair”, “He/She pushed, shoved, or shook me” were used to define dating victimization. Responses ranged from *never* to *often* (6 or more times). For the purposes of this paper, a binary *dating victimization* variable was created (no/yes). Patients were classified as having dating victimization if participants answered “yes” to any of the four items listed above.

2.4.6. Statistical Methods—Data analyses included 1852 respondents and all statistical analyses were performed using SAS version 9.3 for Windows (Copyright © 2011, SAS Institute Inc., Cary, NC, USA). Descriptive statistics were calculated for demographics, substance use and other risk factors, as well as sleep variables (sleep problems, use alcohol to sleep, sleep problem affect life). Bivariate correlational analyses were used to test for correlations between sleep problems and factors that might contribute to sleep problems. Since the severity of sleep problems was not normally distributed in the sample, multivariate negative binomial regression analyses were used to compare the relative strength of associations between these factors and severity of sleep problems. All factors were included in the model with the exceptions of sleep negatively impacting life, and using alcohol to get to sleep, which were presented descriptively and would not be appropriate to include in the model. Nonmedical use of prescription opioids, sedatives, and stimulants were highly

correlated, so these variables were combined into one summary variable. Model statistics showed no evidence of multicollinearity.

3. Results

3.1. Sample characteristics

A total of 3781 patients aged 14-20 years old presented to the ED for a medical (e.g. abdominal pain, back pain) or injury (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] E800 to E999) complaint at any time during calendar year September 2011 – September 2012 (**Figure 2**). There were 1057 (28.0%) patients excluded from the study. There were 617 (22.9%) patients excluded due to missing data and 255 (12.1%) excluded due to refusing to participate at screening.

Regarding refusals, there were no significant differences between participants and those who refused based on gender (13.0% male, 11.5% female; Chi-square (df=1)=1.04; $p>.05$) or age group (12.4% <18, 11.9% ≥18; Chi-square (df=1)=0.13; $p>.05$). Compared to African Americans and Caucasians, individuals of other race groups (i.e., Asian, American-Indian/Alaskan, Native, Hawaiian or other Pacific Islander, and multi-race) were more likely to refuse to participate (29.2%, 8.2%, 8.8%, respectively; Chi-square (df=2)=106.74; $p<0.0001$). Due to IRB regulations, we could only obtain data on age and gender from missed patients. Patients younger than 18 years old were more likely to be missed (26.9%, 23.3%; Chi-square (df=1)=4.33, $p=0.0372$). Males were more likely to be missed than females (29.3%, 21.6%; Chi-square (df=1)=19.26; $p<0.0001$).

With an average response rate of 87.9%, 1,852 participants completed the survey items. **Table 1** provides descriptive statistics of the sample. The sample had a mean age of 17 years; 58.7% were women and 73.6% were white. More than a quarter of participants were on public assistance, and 3.8% had dropped out of school. With regards to substance use, the average AUDIT-C score was 2.0 (SD=2.7), with 27.2% screening positive for unhealthy alcohol use. Marijuana and tobacco use were reported for 31.2% and 27.3% of the sample respectively. Non-medical use of prescription medicine was less common. Turning to other risk factors, 33.3% screened positive for depression, and one in ten reported dating victimization. A majority (65.6%) of subjects presented to the ED with a medical complaint and 34.4% for an injury. More than a quarter (37.6%) reported that sleep difficulties affected their life and 4% used alcohol in order to get to sleep.

3.2. Bivariate correlates of sleep problems

As shown in **Table 2**, the estimated substance use prevalence rates were as follows: 27.2% screened positive for unhealthy alcohol use; 31.2% for marijuana use; and 27.3% for tobacco use. Prevalence rates for nonmedical use of prescription medication were: 4.7% for opioid use; 6.1% for stimulant use; and 3.6% for sedative use. One third of respondents screened positive for depression, and 10.8% reported dating victimization. One quarter screened positive for sleep problems (23.5%); 37.6% complained that sleep difficulties negatively affected an important area of their life; and 4.0% reported using alcohol in order to get to sleep.

Table 2 shows bivariate correlations between severity of sleep problems and other factors that may contribute to these problems. Greater sleep problems were significantly associated with being older in age, being female, receiving public assistance, dropping out of school, having greater unhealthy alcohol use, having marijuana or tobacco use, non-medical use of prescription medication, screening positive for depression, visiting the ED for a medical reason (as opposed to an injury), and dating victimization. Adolescent respondents who reported sleep problems were also more likely to report that sleep difficulties had a negative impact on their life, or that they used alcohol in order to get to sleep.

3.3. Multivariate correlates of sleep problems

As shown in **Table 3**, results from multivariate negative binomial regression analysis indicate that being female, having depression, tobacco use, nonmedical use of prescription medication, having an ED visit for medical reasons (as opposed to for an injury), and dating victimization were associated with severity of sleep problems among adolescents.

4. Discussion

This is the first study to examine factors thought to contribute to sleep problems among adolescents seeking ED services. Findings show that sleep problems are common among these ED patients, with one-quarter of youth screening positive for sleep disturbance. Results from multivariate analyses indicated that being a female, tobacco and nonmedical prescription use, having depression, visiting the ED for a medical reason (as opposed to for an injury) and dating victimization were factors that remained significant to sleep problems among adolescents.

The prevalence of sleep problems found in this study is consistent with that found among a community sample of young adults, where the prevalence was 24.6% and sleep problems were more prevalent among young adult females than males (Breslau et al., 1996). Evidence suggests higher rates of insomnia among females than males (Krystal, 2003), particularly among heavy smokers (Brook et al., 2012).

In the current study sample, greater sleep problems were associated with greater substance use consumption, specifically tobacco and nonmedical prescription use. Vignau and colleagues (1997) examined a sample of French secondary school students, comparing “good sleepers” with “poor sleepers” (a category that included needing more sleep, use of sleeping pills, and insomnia). They found positive associations between being a poor sleeper and use of cigarettes, alcohol inebriation, and illicit drug use (Vignau et al., 1997). Gillin and colleagues (2005) showed that many substances of abuse [for example, caffeine, alcohol, sedatives, hypnotics, anxiolytics, tobacco, prescription stimulants (for narcolepsy) and opioids (for medical analgesia)] produce disrupted sleep and daytime sleepiness, which in turn can promote further substance use to counter these effects. In contrast to a prior study showing an increased prevalence of sleep disturbances in young children with higher injury rates (Owens et al., 2005), our study found that ED visits for medical reasons (as opposed to injury) was associated with greater sleep problems among adolescents. This discrepancy in findings may reflect the fact that all of our participants received medical care in this study (either for an injury or another medical reason). Given the paucity of data on sleep problems

among ED patients, it may be useful to assess sleep problems as part of universal screening approaches in the ED. Future research is needed to better understand these relationships among adolescents.

The current study showed that additional significant markers of sleep problems among adolescents were depression and dating violence. Previous studies from non-ED settings have shown associations between depression and sleep problems (Alfano et al., 2009). Although studies have shown that depression is a longitudinal predictor of later sleep problems (Patten et al., 2000), it is likely these influences are reciprocal in nature. Findings for dating victimization are novel and may reflect psychological or physical consequences of dating violence that could affect sleep, such as depression (Singh et al., 2014). Future research is needed to better understand this relationship.

There are two notable strengths to this study. To begin, it is the first study to our knowledge that examined sleep problems among adolescents presenting to an ED for care. Next, the sample size for this analysis was relatively large. However, some limitations should be noted. First, this investigation was based on self-reported data and did not have objective measures of sleep problems such as polysomnography or actigraphy. Second, although confidentiality was assured and participants' self-administered the survey on computers, this study did not ascertain biological markers of alcohol or other drug use. Third, cross-sectional analyses preclude conclusions about causation. Longitudinal studies are needed that include sleep-specific interviews, assessments, and information about order of onset, to determine etiologies. Fourth, this study did not assess components of negative affect other than depression, such as anxiety. Fifth, this study took place at a single emergency department in the Midwestern United States, which limits the generalizability of findings.

Despite these limitations, the current study provides novel findings regarding the association between sleep problems, depression symptoms and use of alcohol and other substances among adolescents in the ED. Our findings could inform currently recommended substance use screening and intervention approaches in the ED. In order to integrate behavioral health screening into ED settings, screening instruments must be brief and easily scored (Hungerford and Pollock, 2003), with computerized self-administration addressing personnel barriers. In this regard, brief screens which are well suited for this setting include the AUDIT-C (Bush et al., 1998) for alcohol, the PHQ-2 for depression (Richardson et al., 2010), the CADRI for dating violence (Wolfe et al., 2001), and the SPQ for sleep problems (Jenkins et al., 1988). Such intervention approaches could benefit from addressing sleep problems among adolescents, which could be a motive for drug and alcohol use. These findings also underscore the importance of assessing and treating depression and dating violence in addition to substance use among adolescents with sleep problems.

5. Conclusions

These exploratory findings have implications for prevention and intervention efforts aimed at reducing adolescent sleep problems, as well as problems secondary to sleep disorders.

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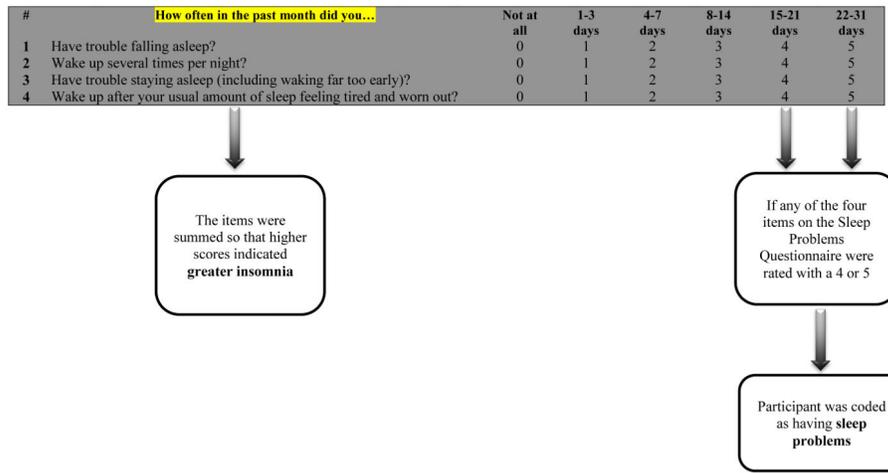


Figure 1.
Sleep Problems Questionnaire

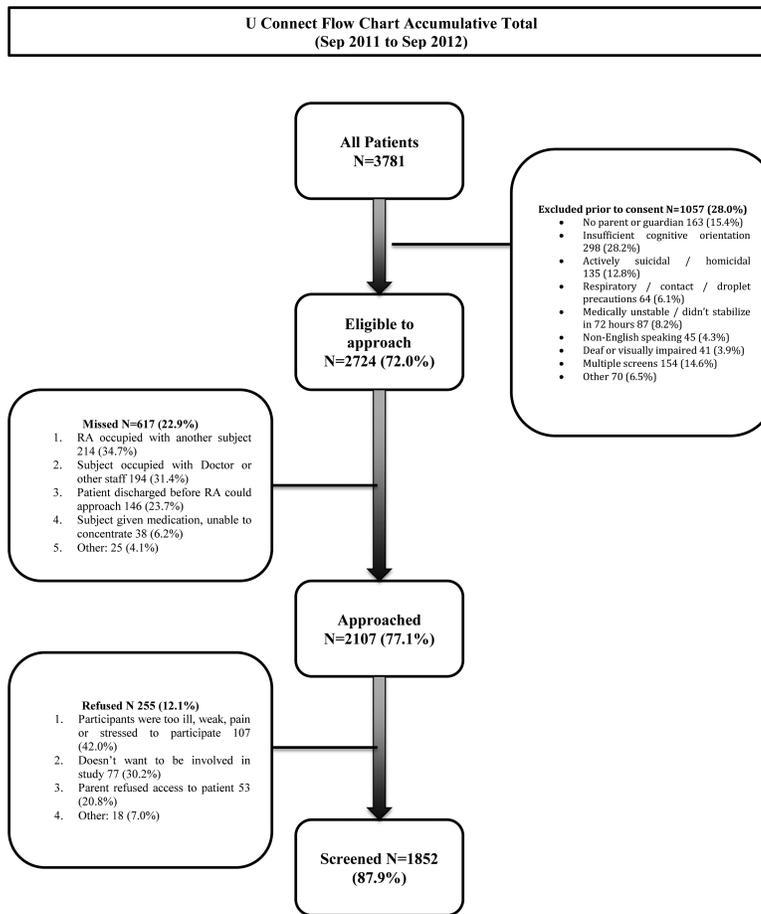


Figure 2.
U Connect Flow Chart Accumulative Total (Sep 2011 to Sep 2012)

Table 1

Frequencies of Demographics, Substance Use, and Other Risk Factors (n=1,852)

Variable	% Mean (SD)
Demographic characteristics	
Age (Range: 14-20 years)	17.4 (± 2.0)
Female	58.7%
White	73.6%
Receiving public assistance	27.4%
Dropped out of school	3.8%
Substance Use	
Unhealthy alcohol use	27.2%
Tobacco use	27.3%
Marijuana use	31.2%
Nonmedical prescription opioid use	4.7%
Nonmedical prescription stimulant use	6.1%
Nonmedical prescription sedative use	3.6%
Other Risk factors	
Depression	33.3%
Medical reason for ED visit	65.5%
Dating victimization	10.8%
Sleep problems negatively impact life	37.6%
Uses alcohol to get to sleep	4.0%

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Table 2

Percentages, means, and bivariate correlations for demographic characteristics, substance use, and other risk factors associated with sleep problems among an Emergency Department (ED) sample of adolescents (n=1,852)

Variable	% [Mean (SD)]	Bivariate Correlation	<i>p</i> value
Demographic characteristics			
Age (Range: 14-20 years)	[17.4 (±2.0)]	.09	< .01
Female	58.7%	.14	< .001
White	73.6%	.03	> .05
Receiving public assistance	27.4%	.06	< .01
Dropped out of school	3.8%	.06	< .05
Substance Use			
Unhealthy alcohol use	27.2%	.11	< .001
Tobacco use	27.3%	.15	< .001
Marijuana use	31.2%	.15	< .001
Nonmedical prescription opioid use	4.7%	.13	< .001
Nonmedical prescription stimulant use	6.1%	.08	< .001
Nonmedical prescription sedative use	3.6%	.18	< .001
Other Risk factors			
Depression	33.3%	.36	< .001
Medical reason for ED visit	65.5%	.15	< .001
Dating victimization	10.8%	.15	< .001
Sleep problems negatively impact life	37.6%	.49	< .001
Uses alcohol to get to sleep	4.0%	.16	< .001

Note: SD: Standard Deviation

Table 3

Multivariate negative binomial regression model examining correlates of severity of adolescent sleep problems among an Emergency Department (ED) sample of adolescents (n=1,852)

Predictor	Incident Rate Ratio (95% CI)	<i>p</i> value
Age	1.01 (0.98, 1.03)	> .05
Gender (female)	1.22 (1.11, 1.34)	< .001
Receives public assistance	1.01 (0.92, 1.12)	> .05
Dropped out of school	1.05 (0.83, 1.33)	> .05
Unhealthy alcohol use	1.09 (0.96, 1.22)	> .05
Tobacco use	1.14 (1.01, 1.28)	< .05
Marijuana use	1.05 (0.94, 1.18)	> .05
Nonmedical prescription use ^a	1.23 (1.06, 1.43)	< .01
Depression	1.77 (1.62, 1.95)	< .001
Medical reason for ED visit	1.23 (1.11, 1.36)	< .001
Dating victimization	1.26 (1.09, 1.45)	< .01

Note: CI: Confidence interval

^aNonmedical prescription opioid, stimulant, or sedative use were combined due to high correlation between these variables.